

### **Chapter 3: Designing complex policy mixes: elements, processes and characteristics <sup>1</sup>**

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#### **Abstract:**

In the last decade, researchers and policy makers alike have increasingly moved away from the consideration of single policy tools and towards a greater consideration of their combination and resulting interactions. Much of this policy design work has used – albeit with varying definitions and based on different bodies of literature – the term policy mix to capture such interacting instruments, may that be in environmental policy, innovation policy, biodiversity policy, or other policy fields. However, these ‘simple’ conceptualizations of policy mixes have been recently extended to a consideration of more ‘complex’ policy mixes, particularly in the context of sustainability transitions, such as the transition to low-carbon energy systems. This chapter will provide an overview of this new orientation in policy mix research, including an introduction to the major building blocks – the elements, processes and characteristics – as well as dimensions of ‘complex’ policy mixes. It concludes by outlining how such an extended policy mix concept can serve as an integrated framework for policy mix evaluation and design.

#### **Keywords:**

Policy mix, policy strategy, policy making and implementation, consistency, coherence, credibility, sustainability transitions, innovation, technological change

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<sup>1</sup> This chapter draws on joint work with Kristin Reichardt focusing on policy mixes for sustainability transitions (Rogge, K.S. and Reichardt, K., 2016. Policy mixes for sustainability transitions: An extended concept and framework for analysis. *Research Policy*, 45(8), pp.1620–1635). As Kristin left academia, she was happy for me to produce this policy design oriented chapter on my own. For this, I have shortened our original work, added recent publications and better embedded our extended policy mix concept in the policy design literature.

## **1 Introduction**

As the previous chapters have shown, over the past two decades policy design has increasingly investigated policy mixes rather than single instruments (Howlett, 2014a; Howlett et al., 2015; Howlett and Lejano, 2013). Such policy mix thinking has received growing interest not only in the policy design literature, but also in other fields, such as in the emerging field of sustainability transitions (Markard et al., 2012). For example, in the context of the move towards decarbonized energy systems policy mixes have been pointed out as key for governing energy transitions (Kivimaa and Kern, 2016; Rogge et al., 2017; Rogge and Reichardt, 2016). In addition, it has been increasingly acknowledged that multiple market and system failures can only be addressed through multi-faceted policy interventions (Braathen, 2007; Lehmann, 2012; Twomey, 2012; Weber and Rohracher, 2012).

Building on the seminal work of Gunningham et al. (1998) researchers and policy makers alike started to pay greater attention to investigating the positive and negative interactions of multiple instruments and their relevance for the effectiveness and efficiency of instrument combinations (del Río González, Pablo, 2006; IEA, 2011a, 2011b; OECD, 2007; Sorrell and Sijm, 2003). However, this focus on instrument interactions and the often ambiguous terminology applied in different policy mix studies have two major consequences for policy design. First, the narrow scope may cause researchers to neglect important policy mix elements or processes in their analyses, potentially leading to insufficient policy design. Second, the lack of a uniform terminology could lead to apparently ambiguous findings and may render policy mix analyses difficult to assess, compare and synthesize.

In this chapter we therefore follow Flanagan et al.'s (2011) call for a reconceptualization of the policy mix which we argue is a prerequisite of future empirical analysis. Here, we take a first step in identifying and defining the key elements, processes, characteristics and dimensions of such an extended policy mix concept. For this, we review and synthesize the literature on policy science, innovation studies, environmental economics, and strategic management. In doing so, we aim at deriving a policy mix concept that assists in a more systematic understanding of the complexity of real-world policy mixes and serves as an integrating framework for policy mix design and analysis.

The remainder of the chapter is structured as follows. In section 2 we review the literature on policy mixes and their characteristics and derive requirements for an extended

policy mix concept. Based on this, in section 3 we present the three building blocks of the proposed policy mix concept: elements (section 3.1), policy processes (section 3.2) and characteristics (section 3.3); and introduce relevant dimensions for delineating policy mixes (section 3.4). Finally, in section 4 we discuss how the extended policy mix concept may be used as an analytical framework - taking the example of investigating the link between policy mixes and socio-technical change - and conclude with outlining some avenues for future research informing policy mix design.

## **2 Literature review**

### **2.1 Policy mix**

A growing number of studies in various scientific fields use the term *policy mix*, including Howlett and Rayner (2007) in the field of policy design, but also Lehmann (2012) in environmental economics and Nauwelaers et al. (2009) in innovation studies. In its most basic form, studies implicitly or explicitly define a policy mix as the combination of several policy instruments (Nauwelaers et al., 2009) or the combination of policy goals and means (Kern and Howlett, 2009). Three general features emerge from the policy mix definitions used in various scientific fields (see Table 1): First, they typically include the ultimate objective(s) of the policy mix, either in an abstract form (Kern and Howlett, 2009) or more typically as a specific objective of a certain policy field, such as innovation (Nauwelaers et al., 2009) or biodiversity (Ring and Schröter-Schlaack, 2011). Second, interaction is a central feature of the existing policy mix definitions (del Río González, 2007; Nauwelaers et al., 2009). Third, some of the definitions point to the dynamic nature of the policy mix, referring to it as having “evolved” (Ring and Schröter-Schlaack, 2011) and “developed incrementally over many years” (Kern and Howlett, 2009).

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Table 1: Definitions of the term *policy mix* in the literature

Scientific field	Source	Definition
Environmental regulation	Gunningham and Grabowsky (1998) (p. 5)	Limitations in environmental policy "can only be overcome by invoking a broader vision of regulation and by the pursuit of broader policy mixes, utilizing combinations of instruments and actors, and taking advantage of various synergies and complementarities between them."
Policy design	Kern and Howlett (2009) (p.395)	"Policy mixes are complex arrangements of multiple goals and means which, in many cases, have developed incrementally over many years."
Innovation studies	Nauwelaers et al. (2009) (p.3)	"A policy mix is defined as: The combination of policy instruments, which interact to influence the quantity and quality of R&D investments in public and private sectors."
Climate economics	Lehmann (2012) (p.1)	"Polluting sources may be affected directly or indirectly by several policies addressing the same pollution problem. This is referred to as a policy mix [...]"
Ecological economics	Ring and Schröter-Schlaack (2011) (p.15)	"A policy mix is a combination of policy instruments which has evolved to influence the quantity and quality of biodiversity conservation and ecosystem service provision in public and private sectors."
Innovation policy studies	Flanagan et al. 2011 (p. 704)	If the policy mix concept "has any utility it must be in forcing our attention to the trade-offs between policies as they impact upon the extent to which the ultimate intended goals or outcomes of innovation policy are realised, in a particular space and at a particular time."
Transition studies	Rogge and Reichardt (2016) (p. 1622)	"[...] we define the policy mix as a combination of the three building blocks elements, processes and characteristics, which can be specified using different dimensions."

Source: Extension of Rogge and Reichardt (2016)

Yet, in many situations a policy mix concept is needed which goes beyond this narrow scope – interacting instruments aimed at achieving objectives in a dynamic setting – at least in two respects. First, it needs to more explicitly incorporate *policy processes* “by which policies emerge, interact and have effects” (Flanagan et al., 2011, p. 702) (i.e. policy design as verb) since such processes and related politics help explain the evolution of policy mixes, but also the resulting effects (Foxon and Pearson, 2007, 2008). Second, it ought to include a *strategic component* which tends to be neglected despite early works of Jänicke on the role of strategic approaches in environmental policy (Jänicke, 1998, 2009). For example, in the context of sustainability transitions the necessity of long time horizons has been stressed (Markard et al., 2012; Nair and Howlett, 2016), and long-term climate targets have been identified to play a key role for companies’ innovation strategies (Rogge et al., 2011; Schmidt et al., 2012).

## 2.2 Characteristics of policy mixes

To describe the nature and performance of policy mixes it is useful to differentiate between policy mix characteristics (Howlett and Rayner, 2007) and assessment criteria

(OECD, 2003a; Sorrell et al., 2003). Terms belonging to the latter group represent well-established ex-ante and ex-post assessment criteria typically applied in evaluations of single policy instruments, such as effectiveness, efficiency, equity or feasibility (del Río, 2014; IRENA, 2012). In contrast, the former group comprises terms specifically used for characterizing the policy mix, such as consistency, coherence, credibility or comprehensiveness (Foxon and Pearson, 2008; Howlett and Rayner, 2007; Kern and Howlett, 2009; Majone, 1997; Rogge and Reichardt, 2016). These design characteristics are not ends in themselves but may impact the performance of a policy mix in terms of the standard assessment criteria.

However, significant differences exist in what is actually meant by these characteristics in different bodies of literatures, rendering interdisciplinary dialogue difficult. We will illustrate this ambiguity for the frequently used but particularly heterogeneously defined terms *consistency* and *coherence* (Den Hertog and Stroß, 2011; Picciotto, 2005), for which we identify three important points to be taken into account when establishing a more uniform terminology that lends itself to interdisciplinary research on policy mix design.

First, consistency and coherence are either seen as *identical or different characteristics*. The former suggests coherence is synonymous with consistency (Carbone, 2008; Hoebink, 2004; Matthews, 2011). As a result, coherence is often simply defined using the term consistency (Hydén, 1999), but there is no uniform definition.<sup>2</sup> In contrast, the latter distinguishes consistency and coherence as different characteristics (Howlett and Rayner, 2007; Mickwitz et al., 2009a; OECD, 2001), but again there is no agreement on the exact nature of this difference. Policy design scholars speak of consistency of instruments and coherence of goals (Howlett and Rayner, 2007) and also introduced congruence among instruments and goals as a third category (Kern and Howlett, 2009) (see chapter 22 in this handbook). Other policy studies assert that coherence is more encompassing than consistency (Jones, 2002; OECD, 2003a). That is, in its most basic form, consistency is seen as the absence of contradictions (Den Hertog and Stroß, 2011; Gauttier, 2004), while coherence calls for an achievement of synergy or positive connections (Missiroli, 2001; Tietje, 1997).

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<sup>2</sup> While some base their definition on the absence of contradictions and non-conflicting signals (Forster and Stokke (1999); van Bommel and Kuindersma (2008)), others refer to the consistency or coherence among policies (Bigsten (2007); Di Francesco (2001); OECD (1996)), while still others speak of consistency or coherence between objectives and instruments (Fukasaku and Hirata (1995); Picciotto (2005)).

Second, the literature differentiates between a *state and process perspective* of consistency and coherence, i.e. between what is being achieved and how it is achieved (Carbone, 2008), but again this is not treated uniformly. A first set of studies addresses the state of affairs at a certain point in time only (Duraiappah and Bhardwaj, 2007; Fukasaku and Hirata, 1995; Hoebink, 2004). A second set instead captures the process perspective (Jones, 2002; Lockhart, 2005; OECD, 2003a), often concentrating on the organizational or institutional setup to attain consistency/coherence. A third set of studies mentions – either implicitly or explicitly – both state and process perspectives, but uses the same term – typically coherence – for both (Den Hertog and Stroß, 2011; Forster and Stokke, 1999; McLean Hilker, 2004).

Third, some studies focus on *tools* for enhancing consistency and coherence (Ashoff, 2005; OECD, 1996, 2003a), a discussion which is closely linked to the literature on policy coordination<sup>3</sup> and integration<sup>4</sup> (Howlett et al., 2017; Magro et al., 2014; Mickwitz et al., 2009a; van Bommel and Kuindersma, 2008). However, as before, there is no common understanding of the terms consistency and coherence and how they relate to other concepts, such as coordination.

One reason for this lack of a uniform terminology may be the often largely separated contributions addressing distinct policy fields, such as development policy (EU, 2005; Weston and Pierre-Antoine, 2003), climate and energy policy (Matthes, 2010; Mickwitz et al., 2009b) and eco-innovation policy (Reid and Miedzinski, 2008; Ruud and Larsen, 2004). We argue that such diversity in meaning and the resulting difficulties in integrating findings across studies is hindering advances in policy design research on policy mixes. Therefore, future research would benefit from applying uniform definitions which fulfill the following two requirements: First, these definitions need to clearly specify whether they refer to the output (policy design as noun) or process perspective of the policy mix (policy design as verb), which might best be accomplished by separate terms for each of these perspectives. Second, at a minimum they should allow for the

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<sup>3</sup> Policy coordination is a formal policy process aiming to get “the various institutional and managerial systems, which formulate policy, to work together” (OECD (2003a), p. 9). Subsets of policy coordination are cooperation and collaboration Bouckaert et al. (2010).

<sup>4</sup> Environmental policy integration means “the incorporation of environmental objectives into all stages of policy making in non-environmental policy sectors [...] accompanied by an attempt to aggregate presumed environmental consequences into an overall evaluation of policy, and a commitment to minimise contradictions between environmental and sectoral policies” (Lafferty and Hovden (2003), p. 9).

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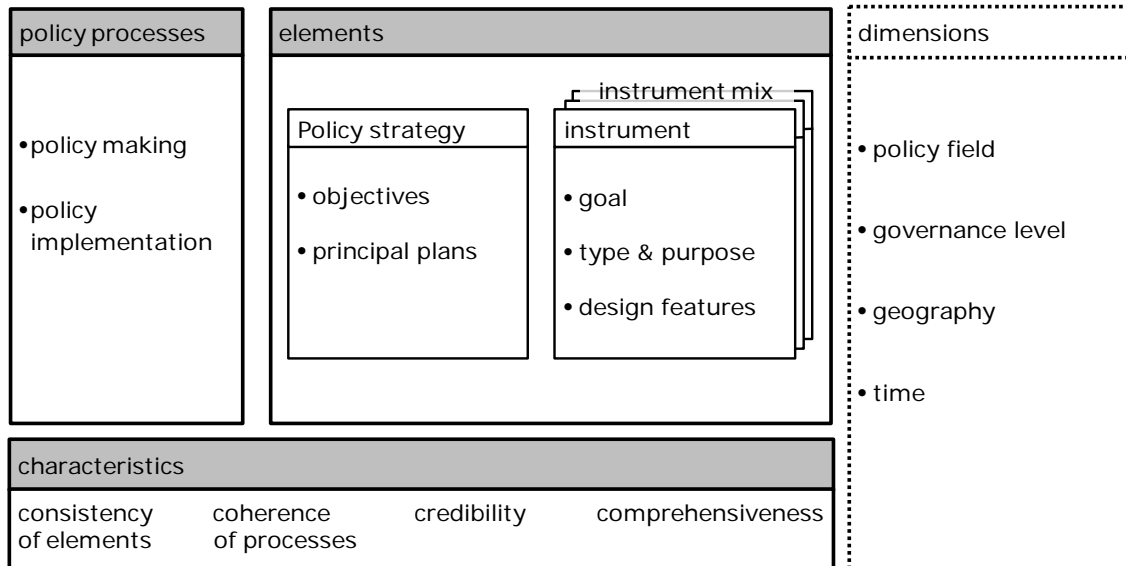
differentiation of a weak and strong form to capture the distinction between the absence of contradictions and actual synergies within a policy mix.

### **3 Building blocks of the policy mix concept**

As derived in the literature review, an extended policy mix concept for dealing with the complexity of real world policy mixes needs to address three basic requirements: first, the inclusion of a *strategic component*, second, the incorporation of associated *policy processes*, and third, the enhanced consideration of *characteristics* of policy mixes. In capturing this complexity of actual policy mixes it should also pay attention to their dynamic nature.

Based on these requirements, Rogge and Reichardt (2016) have defined the policy mix as a combination of the three building blocks elements, processes and characteristics, which can be specified using different dimensions. *Elements* comprise the (i) policy strategy with its objectives and principal plans for achieving them and (ii) the instrument mix with its interacting policy instruments - and thus the elements of a policy mix capture policy design as noun. The content of these elements is a result of *policy processes* - and thus these processes of policy making and implementation reflect policy design as verb. Both elements and processes can be described by their *characteristics*, including – but not limited to – the consistency of elements, the coherence of processes, or the credibility and comprehensiveness of a policy mix. Finally, the policy mix can be delineated by several dimensions, including – but again not limited to – policy field, governance level, geography and time.

Figure 1: Building blocks of an extended policy mix concept



Source: Rogge and Reichardt (2016)

### 3.1 Building block 1: Elements

#### 3.1.1 Policy strategy

The importance of a long-term strategic orientation and strategic policy frameworks has been increasingly underscored in the literature, for example regarding sustainability transitions (Foxon and Pearson, 2008; Quitzow, 2015; Weber and Rohrer, 2012) and policy-triggered environmental technological change (Rogge et al., 2011; Schmidt et al., 2012). Policy strategy has therefore been incorporated as one of the elements in the policy mix concept. Building on the strategic management literature in general (Miles and Snow, 1978; Mintzberg et al., 1998) and Andrews (1987) and Porter (1980) in particular, the policy strategy is defined as a combination of policy objectives and the principal plans for achieving them. That is, the definition puts an emphasis on the output – the ends and means – of the strategy process, while the adaptive process of formulating, implementing and revising objectives and plans is captured by the processes building block (see section 3.2).

The first component of the policy strategy definition concerns *policy objectives*, such as mitigating climate change and greening the economy. These objectives tend to be substantiated by long-term *targets* with quantified ambition levels, such as greenhouse gas



reductions by 2050, and may be based on visions of the future (del Río, 2010; Kemp and Rotmans, 2005).<sup>5</sup> Besides content-oriented objectives, a policy strategy can also contain process and learning objectives (Kemp, 2007; Nair and Howlett, 2017; Rotmans et al., 2001), for example in terms of the build-up or enhancement of the strategic capacity of governments (OECD, 2015; Quitzow, 2015) or reflexivity of governance systems (Lindner et al., 2016).

The second component of the strategy definition addresses the *principal plans* for achieving these objectives. Such plans outline the general path that governments propose to take for the attainment of their objectives and include framework conventions, guidelines, strategic action plans and roadmaps which typically surpass electoral cycles, such as the EU Strategic Energy Technology (SET) Plan or the German Energy Concept.

The long-term perspective inherent in the policy strategy (Hillman and Hitt, 1999) can play a fundamental role in giving direction to actions and decisions (Grant, 2005) and providing actors with needed guidance in their search for solutions (Hekkert et al., 2007). For example, research has shown the vital role of ambitious and stable long-term climate targets in steering R&D activities of companies in the power sector (Rogge et al., 2011; Schmidt et al., 2012). However, the same research has also pointed out that this strategic element of the policy mix on its own is not sufficient to change companies' innovation strategies but needs to be operationalized through concrete policy instruments.

### **3.1.2 Instruments**

As the second element in the policy mix, policy instruments constitute the concrete tools to achieve overarching objectives. More precisely, they can be seen as tools (Salamon, 2002) or techniques of governance (Howlett, 2005) that address policy problems (Pal, 2006). They are introduced by a governing body (Sorrell et al., 2003) in order to achieve policy objectives (Howlett and Rayner, 2007), thereby translating plans of action (de Heide, 2011). A number of alternative terms are used, such as implementing measures (EU, 2013), programs (Komor and Bazilian, 2005), policies (IRENA, 2012), or policies and measures (UNFCCC, 2011).

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<sup>5</sup> Targets can be characterized by a number of factors, including their ambition level, their type (e.g. specific, absolute), their governance level (e.g. EU, national), their scope (e.g. headline target, sub-target), their time horizon (e.g. long-term, interim), or their legal nature (e.g. binding, aspirational, voluntary), see EU (2013) and Philibert and Pershing (2001).

Policy instruments are typically associated with specific *goals* which cover the intended effect of instruments that contribute to achieving overarching policy objectives. In addition, two key calibrations of policy instruments are particularly relevant for policy design, namely instrument *type* (section 3.1.2.1) and instrument *design feature* (section 3.1.2.2).

### **3.1.2.1 Instrument type**

In the policy design literature much attention has been devoted to developing taxonomies of instruments (see chapter 5, and part IV of this handbook). Here, we want to illustrate the importance of considering different instrument type when designing policy mixes for the example of environmental and innovation policy (Hufnagl, 2010; Nauwelaers et al., 2009; Sterner and Coria, 2011). for which we propose a 3x3 matrix typology (see Table 2) that combines three instrument types (economic instruments, regulation and information) with three instrument purposes (technology push, demand pull and systemic concerns). By including information and systemic instruments, i.e. those “instruments that support functions operating at system level” (Smits and Kuhlmann, 2004, p. 25) <sup>6</sup>, the typology captures both substantive and procedural instruments (Howlett, 2000). Of course, such a matrix is an oversimplification of reality, and as such not free of overlaps, which is recognized by qualifying both instrument purpose and type with the word ‘primary’.

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<sup>6</sup> Smits and Kuhlmann (2004), p. 25, distinguish between five systemic functions: “management of interfaces, building and organizing systems, providing a platform for learning and experimenting, provision of strategic intelligence and demand articulation.”

Table 2: Exemplary type-purpose instrument typology (with instrument examples)

PRIMARY TYPE	PRIMARY PURPOSE		
	Technology push	Demand pull	Systemic
Economic instruments	RD&D* grants and loans, tax incentives, state equity assistance	Subsidies, feed-in tariffs, trading systems, taxes, levies, deposit-refund-systems, public procurement, export credit guarantees	Tax and subsidy reforms, infrastructure provision, cooperative RD&D grants
Regulation	Patent law, intellectual property rights	Technology / performance standards, prohibition of products / practices, application constraints	Market design, grid access guarantee, priority feed-in, environmental liability law
Information	Professional training and qualification, entrepreneurship training, scientific workshops	Training on new technologies, rating and labelling programs, public information campaigns	Education system, thematic meetings, public debates, cooperative RD&D* programs, clusters

\* RD&D = Research, development and demonstration

Source: Rogge and Reichardt (2016)

### 3.1.2.2 Instrument design features

A policy instrument's design features may be more influential for achieving policy objectives, such as innovation, than the instrument type (Kemp and Pontoglio, 2011; Vollebergh, 2007). Therefore, an increasing number of studies explicitly consider them when analyzing policy instruments and their effects, such as regarding environmental innovation (Ashford et al., 1985; Blazejczak et al., 1999; Norberg-Bohm, 1999). In addition, design features may also impact an instrument's effectiveness and efficiency and may be a prerequisite for interaction analyses (del Río, 2009).

As such, design features are key for policy designers and can be differentiated by abstract and descriptive features. *Descriptive design features*, such as an instrument's legal form<sup>7</sup>, its target actors, and its duration, summarize the content of a policy instrument (del Río, 2012), which can serve as a first step in identifying how a policy instrument performs regarding abstract design features. A number of *abstract design features* have

<sup>7</sup> The legal form determines, for example, the binding character of an instrument, which can range from voluntary agreements to compulsory measures.

been proposed in the literature (Haščic et al., 2009; Kemp and Pontoglio, 2011)<sup>8</sup>, but there is no universally accepted list. We argue that at least the following six may be important to consider: stringency, level of support, predictability, flexibility, differentiation and depth.

First, *stringency* addresses the ambition level of an instrument and is typically associated with regulatory and economic instruments, such as emissions standards or emissions trading. It can refer both to an instrument's goal and its design, with the individually perceived stringency ultimately determined by the characteristics of the instrument's target actor, such as its technology portfolio. For example, findings point to a positive impact of stringency on innovation, despite differences in definitions and operationalizations of stringency across studies (Fronzel et al., 2007; Ghisetti and Pontoni, 2015; Rogge et al., 2011).

Second, *level of support* captures the magnitude of positive incentives provided by a policy instrument, which may be particularly relevant for instruments providing financial incentives. A prime example is the level of feed-in tariffs, which aim at increasing the return on investments in renewable power generation technologies (Steinheilber et al., 2011).

Third, *predictability*, having gained attention particularly in relation to the EU ETS and a post-Kyoto international climate agreement (Engau and Hoffmann, 2009; Hoffmann et al., 2008), "captures the degree of certainty associated with a policy instrument and its future development. This concerns the instrument's overall direction, detailed rules, and timing" (Rogge et al., 2011, p. 515). As such it ultimately addresses the effect of a policy instrument on investor uncertainty (Haščic et al., 2009), which may be particularly important for long-lived capital-intensive investments and RD&D decisions. For example, the German EEG increases its predictability by granting support to investors for 20 years.

Fourth, *flexibility* captures the extent to which innovators are allowed to freely choose their preferred way of achieving compliance with an instrument (Kivimaa and Mickwitz, 2006; Norberg-Bohm, 1999). Johnstone and Haščic (2009, p. 1) find that for "a given level of policy stringency, countries with more flexible environmental policies are more

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<sup>8</sup> Not all of the abstract design features found in the literature concern instruments only, but also include aspects relevant for policy making and implementation, such as continuous improvement (Kivimaa and Mickwitz (2006)) and enforcement (Kemp (1997)), as well as for the overall policy mix, such as credibility (Kemp and Pontoglio (2011)).

likely to generate innovations which are diffused widely and are more likely to benefit from innovations generated elsewhere”.

A fifth abstract design feature concerns the *differentiation* specified in policy instruments (Kemp and Pontoglio, 2011), e.g. with regard to industrial sector, size of the plant, technology or geographical location. Sixth, the *depth* of the policy instrument addresses the range of its incentives, such as whether its incentives extend all the way to potential solutions with zero emissions (Haščic et al., 2009).

The interwoven nature of design features requires them to be mutually balanced (Kemp, 2007). For example, empirical studies recommend a gradual tightening of the stringency in a predictable manner, while at the same time providing enough flexibility to allow for the exploration of new developments (Kivimaa 2007).

### **3.1.3 Instrument mix**

Moving from single instruments to their combination brings us to the instrument mix, which represents only one aspect of the overarching policy mix. Regarding the instruments in this mix it may be useful for policy designers to distinguish between core (or cornerstone) instruments and complementary (or supplementary) instruments of an instrument mix (IEA, 2011b; Matthes, 2010; Schmidt et al., 2012). In addition, policy designers may be faced with different hierarchies of instruments which will determine the design space for subordinate instruments.

At the heart of the concept of instrument mixes are *interactions* between the instruments, which signify “that the influence of one policy instrument is modified by the co-existence of other [instruments]” (Nauwelaers et al., 2009, p. 4). This influence originates from the direct or indirect effect that the operation or outcomes of instruments have on each other (Oikonomou and Jepma, 2008; Sorrell et al., 2003). Clearly, these interdependencies of instruments largely influence the combined effect of the instrument mix and thus the achievement of policy objectives (Flanagan et al., 2011).

However, as pointed out by Gunningham et al. (1998), without considering the particular context in which interactions occur, only tentative conclusions on instrument interactions can be reached, thus calling for empirical analyses. Such analyses ought to understand the mechanisms and consequences of policy interactions, which requires considering a number of aspects, including the scope of the interacting instruments, the nature of their goals, their timing, and operation and implementation processes (Sorrell

et al., 2003). This suggests that interaction outcomes are not only determined by the instrument mix but also shaped by the overarching policy mix.

Instrument interactions have been predominantly dealt with in the environmental domain, particularly on climate and energy issues (Spyridaki and Flamos, 2014). More recently, innovation studies have also started to highlight interactions (Cantner et al., 2016; Flanagan et al., 2011; Guerzoni and Raiteri, 2015). Overall, these studies acknowledge the need to avoid negative interactions and to strive for positive or complementary interaction outcomes.

### **3.2 Building block 2: Policy processes**

Rather than looking only at the content of the policy strategy and instrument mix with its interacting instruments (design as noun), we now turn our attention to the policy making process (design as verb), or *policy process* for short (Dunn 2004; Dye 2008). It is these processes that determine the elements of the policy mix and thus how both the strategy and corresponding instruments change over time. In addition, policy processes may also influence policy outcomes and impacts more directly, as for example shown for the case of offshore wind (Reichardt et al., 2017). Given their importance these processes (Howlett and Rayner, 2007; Kay, 2006; Majone, 1976) they constitute another building block of the extended policy mix concept.

Building on Howlett et al. (2009), Sabatier and Weible (2014) and Capano et al. (2014) we refer to the policy process as political problem-solving process among constrained social actors in the search for solutions to societal problems – with the government as primary agent taking conscious, deliberate, authoritative and often interrelated decisions. As such, these interactive and continuous reconciliation processes with various feedback loops involve power, agency and politics (see chapter 18 in this handbook). For example, this political dimension has been pointed out in the context of sustainability transitions with their complex and messy policy processes with a plethora of involved actors and their conflicting interests and ideas (Meadowcroft, 2009; Stirling, 2014). Finally, policy processes are shaped by socio-economic conditions, infrastructure and biophysical conditions, but also by culture and institutions (Sabatier and Weible, 2014), and can thus differ significantly across space and time. Studying such processes can draw on various theories of the policy process (Sabatier and Weible, 2014). However, as has

been pointed out in the context of analyzing sustainability transitions many studies applying policy process theories do not assume a policy mix perspective, but much could be gained from doing so (Kern and Rogge, 2017).

Policy processes cover all stages of the policy cycle, including problem identification, agenda setting, policy formulation, legitimization and adoption, implementation, evaluation or assessment, policy adaptation, succession and termination (Dunn, 2004; Dye, 2008; Howlett et al., 2009; Schubert and Bandelow, 2009). As such, the policy making process can be seen “as a cycle of problem-solving attempts, which result in ‘*policy learning*’ through the repeated analysis of problems and experimentation with solutions” (Howlett et al., 2009, p. 3). This ongoing and reactive nature of policy processes both shapes the setting and adjustment of the policy strategy as well as the (re)design of instruments in the mix (through layering, stretching, patching and packaging, see chapter 28 in this handbook), both through processes of design and non-design (Howlett and Mukherjee, 2014) (see chapter 17 in this handbook).

Regarding *policy making*, we stress two aspects: First, policy adaptation and policy learning is a crucial feature of policy making processes, particularly when dealing with dynamic, multifaceted and uncertain policy challenges, such as sustainability transitions (Allen et al., 2011; Bennett and Howlett, 1992; Boekholt, 2010; Kemp et al., 2007; Loorbach, 2007; Nair and Howlett, 2017). To facilitate such interactive processes, the monitoring and evaluation of the impacts of policy mixes are of fundamental importance (Kemp, 2011). Also, participatory processes of envisioning, negotiating, learning and experimenting can strengthen policy learning (Frantzeskaki et al., 2012; Schot and Steinmueller, 2016). Second, policy making is a highly political process characterized by resistance to change, particularly from actors with vested interests (Geels, 2014; Meadowcroft, 2009). In that sense, the adoption of a policy strategy with clear objectives but without the simultaneous adoption of a set of instruments – while inconsistent – can be understood as an attempt of setting the agenda for upcoming changes in the instrument mix, therefore providing direction. However, given the political nature of policy making processes it may remain difficult to radically adjust the instrument mix even if new policy objectives are in place. This may be one reason why new instruments supporting new solutions, such as renewable energies, may be added to those supporting the existing ones, such as fossil fuels, instead of replacing (Kern and Howlett, 2009) or reforming them (see chapter 15 in this handbook).



By *policy implementation* we mean “the arrangements by authorities and other actors for putting policy instruments into action” (Nilsson et al., 2012, figure 1), that is, for executing and enforcing them (Sabatier and Mazmanian, 1981). Complex and insufficient implementation structures but also political resistance at sub-ordinate governance levels may lead to implementation difficulties such that ultimately a policy instrument may not tap its full potential (Howlett et al., 2006; Howlett et al., 2017). Such difficulties may partly be overcome by an appropriate crafting of policy instruments (May, 2003; Mazmanian and Sabatier, 1981), including the provision of sufficient funding and staff for implementation.

Finally, at a more abstract level we highlight the role of the style of policy processes. More precisely, we refer to the policy making and implementation style, i.e. the “standard operating procedures for making and implementing policies” (Richardson, 1982, p. 2). The policy style captures, for example, the typical kind of goal setting or flexibility in instrument application (Blazejczak et al., 1999; Jänicke et al., 2000). As is put forward in Chapter 19, implementation styles vary across different types of policy design. Here we argue that policy styles may directly and indirectly influence the policy mix and its performance (Reichardt et al., 2017).

### **3.3 Building block 3: Characteristics**

Overarching *characteristics* describe the policy mix and may be important determinants for its performance regarding standard assessment criteria, such as its effectiveness. While some characteristics, such as consistency and coherence, have long been acknowledged in policy design studies (Howlett and Rayner, 2007; Kern and Howlett, 2009, see chapter 22 in this handbook), others have been added more recently to the list of potential policy mix characteristics, such as policy credibility (Bosetti and Victor, 2011; Brunner et al., 2012; Nemet et al., 2017). In the following, we outline four policy mix characteristics – consistency, coherence, comprehensiveness and credibility – but acknowledge that this list is far from complete. For example, in the context of clean energy innovation the balance of a mix (Costantini et al., 2017) and its stability (Rogge and Reichardt, 2013) have been discussed as further policy mix characteristics.

#### **3.3.1 Consistency of elements**

We suggest that *consistency* captures how well the elements of the policy mix are aligned with each other, thereby contributing to the achievement of policy objectives. It



may range from the absence of contradictions to the existence of synergies within and between the elements of the policy mix.

We highlight two key features of this consistency definition. First, it focuses on the *state of the elements* of the policy mix at any given point in time, i.e. its content. In this regard, the development of the alignment of the elements of the policy mix over time is captured by the term temporal consistency. Second, it may be most useful to understand consistency in relative terms, i.e. differentiating between the degree of consistency and its variation across dimensions, such as time, geography or governance level. A consistent policy mix at a minimum needs to be free of contradictions or conflicts (Forster and Stokke, 1999), as this may impair the achievement of objectives (Ashoff, 2005; Hoebink, 2004; McLean Hilker, 2004). If on top of such weak consistency complementarities, mutual support and synergies exist we refer to this as strong consistency. However, in reality such consistency may not be possible to achieve, for example due to conflicting objectives (see below).

We distinguish between consistency of the policy strategy, consistency of the instrument mix, and consistency of the instrument mix with the policy strategy. First, consistency of the *policy strategy* incorporates the alignment of policy objectives (Mickwitz et al., 2009a; OECD, 2003a), which suggests that these can be achieved simultaneously without any significant trade-offs. This is important since conflicting objectives are a major source of tension between the instruments in a policy mix (Flanagan et al., 2011). Examples are whether climate targets are consistent with energy security or competitiveness targets, or whether interim targets are consistent with long-term targets. In addition, it captures whether principal plans, i.e. framework conventions, guidelines, strategic action plans and roadmaps, are free of contradictions or mutually supportive. This first level of consistency also captures whether these plans are consistent with policy objectives.

The second level of consistency concerns the *instrument mix* and can be assessed through interaction analysis. The instruments in an instrument mix are consistent when they reinforce rather than undermine each other in the pursuit of policy objectives (Howlett and Rayner, 2013). "They are inconsistent when they work against each other and are counterproductive" (Kern and Howlett, 2009, p. 396). Therefore, strong instrument mix consistency is associated with positive interactions, weak instrument mix consistency is characterized by neutral interactions, while instrument mix inconsistency is captured by negative interactions (del Río, 2009, 2010; IEA, 2011b; Sorrell et al., 2003).

Finally, third level policy mix consistency addresses the *interplay of the instrument mix and the policy strategy*. This overall policy mix consistency is characterized by the ability of the policy strategy and the instrument mix to work together in a unidirectional or mutually supportive fashion (Howlett and Rayner, 2013), thereby contributing to the achievement of policy objectives. Thus, a higher degree of first- and second-level consistency positively influences the degree of third-level consistency. This implies that a consistent policy strategy is implemented by a consistent instrument mix encompassing instruments with design features capable of reaching the objectives.

### **3.3.2 Coherence of processes**

To characterize policy processes we use the term *coherence*, thereby following studies that focus on the process dimension (Den Hertog and Stroß, 2011; OECD, 2001, 2003a, 2003b). Building on Jones (2002) we suggest defining policy coherence as referring to synergistic and systematic policy making and implementation processes contributing – either directly or indirectly – towards the achievement of policy objectives. Such more synergistic and systematic policy processes may be achieved through a number of structural and procedural mechanisms, such as strategic planning, coordinating structures and communication networks (Ashoff, 2005; den Hertog et al., 2004; Giest, 2015; OECD, 1996, 2001).

We highlight two key features of this definition. First, it addresses the coherence of policy processes *across different policy fields and governance levels*. These processes shape all elements of the policy mix, thereby underlining that neither the policy strategy nor instruments are seen as given. Second, it points to the need of systematic capabilities of policy makers (Jacobsson and Bergek, 2011; Rayner and Howlett, 2009). That is, coherence of policy making and implementation requires advanced organizational capacities, including, for example, the ability to assemble related knowledge from diverse sources, to build networks with all relevant actors, to engage with multiple stakeholders, to anticipate future developments, or to self-reflect on values, processes and tools (Howlett and Ramesh, 2016; Lindner et al., 2016; OECD, 2015; Quitzow, 2015).

Two major tools for improving policy coherence are *policy integration* (Candel and Biesbroek, 2016; Howlett et al., 2017; OECD, 2003a; Underdal, 1980) and *coordination*

(Bouckaert et al., 2010; Magro et al., 2014; OECD, 1996).<sup>9</sup> The former can improve policy coherence by enabling a more holistic thinking across different policy sectors, at the same time involving more holistic processes. In contrast, the latter can strengthen coherence by aligning the tasks and efforts of public sector organizations, e.g. in enhancing information flows through formal mechanisms.

In conclusion, we want to stress that it may be impossible to actually achieve complete coherence and consistency (Carbone, 2008; Hoebink, 2004; McLean Hilker, 2004). Reasons for this may include the complexity of the systems and associated policy challenges, including path dependence and lock-in, resistance of actors with vested interests, conflicting interests and tensions, policy myopia and fragmentation of policy making (Howlett, 2014b; Meadowcroft, 2007; Nair and Howlett, 2017; Unruh, 2000, 2002). Therefore, “the aim is to make progress towards maximum coherence within the limited resources available” (McLean Hilker, 2004, p. 4), thereby also striving to maximize policy mix consistency. Yet, ultimately neither coherence nor consistency should be seen as goal in itself but rather as means for improving the performance of a policy mix.

### **3.3.3 Credibility**

In addition to consistency and coherence, credibility may also be relevant for describing the nature of policy mixes, particularly when dealing with long-term policy challenges which require longer time horizons, such as is the case for sustainability transitions. Here, we define credibility as the extent to which the policy mix is believable and reliable, both overall and regarding its elements and processes. Such policy credibility refers to the challenges that short time horizons (electoral cycles) pose for policy makers’ credibility (Kydland and Prescott, 1977), with delegation suggested as one solution (Gilardi, 2002; Majone, 1997). This classic argument has been applied in the environmental realm (Bradshaw, 2003), and particularly in climate policy (Helm, 2003).

Given that a lack of credible commitments to future climate policy has been identified as raising compliance costs substantially (Bosetti and Victor, 2011; Cian et al., 2012), there is a growing interest in exploring solutions to such commitment problems (Bruner et al., 2012; Nemet et al., 2017). Accordingly, policy credibility may be influenced

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<sup>9</sup> While some studies view coherence as equivalent to integration and coordination (Duraiappah and Bhardwaj (2007); Geerlings and Stead (2003)), we follow others in seeing them as distinct formalized tools for improving policy coherence (Carbone (2008); Di Francesco (2001); McLean Hilker (2004); OECD (2003a)).

by institutional and policy design, such as the delegation of competencies to independent agencies, the provision of transparency and trust, or decentralized policy making. In addition, the operationalization of targets by a consistent instrument mix may enhance the credibility of the policy mix (Reichardt and Rogge, 2016). Ultimately, we argue that the credibility of the policy mix may play an important role in the achievement of policy objectives, such as those related to sustainability transitions, and thus may play a central role for policy design.

### **3.3.4 Comprehensiveness**

Another policy mix characteristic that has been suggested to be of relevance for sustainability transitions is *comprehensiveness* (Costantini et al., 2017; Sovacool, 2009). Following further conceptualizations in the management literature (Atuahene-Gima and Murray, 2004; Miller, 2008) here we define it to capture how extensive and exhaustive its elements are and the degree to which its processes are based on extensive decision-making.

That is, comprehensiveness of the elements of the policy mix implies that the policy mix is constituted of both a policy strategy with its objectives and principal plans and at least one instrument in the instrument mix operationalizing the policy strategy. The comprehensiveness of this instrument mix is determined by the degree to which the instrument mix addresses all relevant market, system and institutional failures, including barriers and bottlenecks (Lehmann, 2012; Sorrell et al., 2004; Weber and Rohrer, 2012). As such, a comprehensive instrument mix may address all instrument purposes, such as in the case of innovation policy of technology-push, demand-pull and systemic concerns. Another example from the field of energy efficiency policy is to assess the comprehensiveness of instrument mixes in terms of technology-specificity and the level of complexity and costliness of energy efficiency measures (Rosenow et al., 2017). By contrast, the comprehensiveness of policy processes can be influenced by their structure, rigor and thoroughness (Atuahene-Gima and Murray, 2004).

## **3.4 Dimensions**

All three building blocks of the policy mix concept can be specified along a number of dimensions, such as the policy field, governance level, geography, and time. These dimensions capture the space in which interactions can occur (Flanagan et al., 2011) by pointing to the origin of the different components of the policy mix.

The first dimension *policy field* refers to the policy domain, such as energy, environmental, climate, innovation, technology, science, industrial and transition policy (van den Bergh et al., 2007). Analyzing policy mixes across policy fields matters because internal and external inconsistencies and incoherencies within and across policy fields could render these mixes ineffective (Huttunen et al., 2014).

For the second dimension *governance level* we focus on the distinction between vertical and horizontal governance, a distinction typically made in studies on policy coherence and consistency (Carbone 2008; den Hertog et al. 2004; Pal 2006) and policy integration (Howlett et al., 2017). The vertical level differentiates, for example, between the EU and its Member States as well as between international, federal or local levels. It further distinguishes between government departments and implementing agencies. In contrast, the horizontal level allows for differentiating between different political or administrative entities at the same vertical governance level, such as federal departments of different policy fields.

Third, the *geography* dimension relates to the space from which the policy mix originates, and reflects the increasing attention to the geographical perspective, such as in transition studies (Coenen et al., 2012; Raven et al., 2012; Späth and Rohrer, 2012). An example of this is a regional policy strategy and instruments targeted towards a certain geographical region (Navarro et al., 2014).

Finally, *time* is another crucial dimension of policy mixes, capturing their dynamic nature (Flanagan et al., 2011; Howlett and Goetz, 2014; Newman and Howlett, 2014). That is, a policy mix develops over time in terms of its elements, processes and characteristics. First, the *elements* of the policy mix change over time, with new instruments and goals having been added, existing ones amended and others terminated in processes of policy packaging or patching (Howlett and Rayner, 2013; Kern et al., 2017). Policy instruments may not only change in terms of their contents, ideally resulting in continuous improvement (Kivimaa, 2007), but also in terms of their effects as they are interpreted against changing rationales (Flanagan et al., 2011) and changing contexts. Similarly and resulting from changing instruments, interactions are not stable over time either, which may cause the instrument mix to drift out of alignment (IEA, 2011b; Sorrell et al., 2003).

Second, policy *processes* may also change over time (Flanagan et al., 2011). In fact, it has been argued that policy making should be designed to ensure adaptation and policy learning under conditions of deep uncertainty (Allen et al., 2011; Haasnoot et al., 2013; Nair and Howlett, 2017). That is, adaptive policy making allows for adjusting the policy

mix as “the world changes and new information becomes available” (Walker et al., 2001, p. 283), thereby or example enabling policy learning for transitions (Loorbach, 2007; Rotmans et al., 2001). Such policy learning, including from policy failure (Bennett and Howlett, 1992; Dunlop, 2017) is key for designing policy mixes for sustainability transitions.

Finally, *characteristics* can change over time. For example, large unexpected changes in policy instruments may lead to temporal inconsistency of the instrument mix and thus to a loss of credibility (White et al., 2013). In contrast, the compliance with long-term targets set beyond electoral cycles may be one factor through which policy credibility can be build up over time (Nemet et al., 2014). Another example concerns increases of coherence due to a move away from unscheduled ad-hoc changes to advanced planning, prior announcements and stakeholder participation in the light of envisaged changes to the policy mix.

## **4 Conclusion**

This chapter argued for paying greater attention to the complexity and dynamics of real-world policy mixes. Specifically, it stressed that policy mix design goes beyond the combination and evolution of interacting instruments and goals, but should adopt a broader scope. This includes the expanded consideration of policy mix characteristics, such as policy credibility, and the explicit coverage of policy strategies with their long-term targets. It also implies a balanced treatment of policy design (the noun) and policy designing (the verb) by strengthening the analysis of policy processes, and doing so in an integrated manner.

Since the extended policy mix concept presented here draws on several disciplines and aims for interdisciplinary research into policy mixes, we have identified and attempted to reconcile some ambiguities in the treatment of key terms. As such, the idea was to build bridges between different policy mix conceptualizations of use to policy designers. For example, Howlett and Cashore (2009) pointed to the importance of distinguishing policy to enable a better understanding of policy change, suggesting three levels for policy content and two levels of policy focus. Building on this distinction and combining it with the extended policy mix concept proposed by Rogge and Reichardt (2016) could lead to an updated focus-content-matrix which explicitly adds a strategy level and highlights policy processes (see Table 3).

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Table 3: Implications of broader policy mix perspective for focus-content-matrix

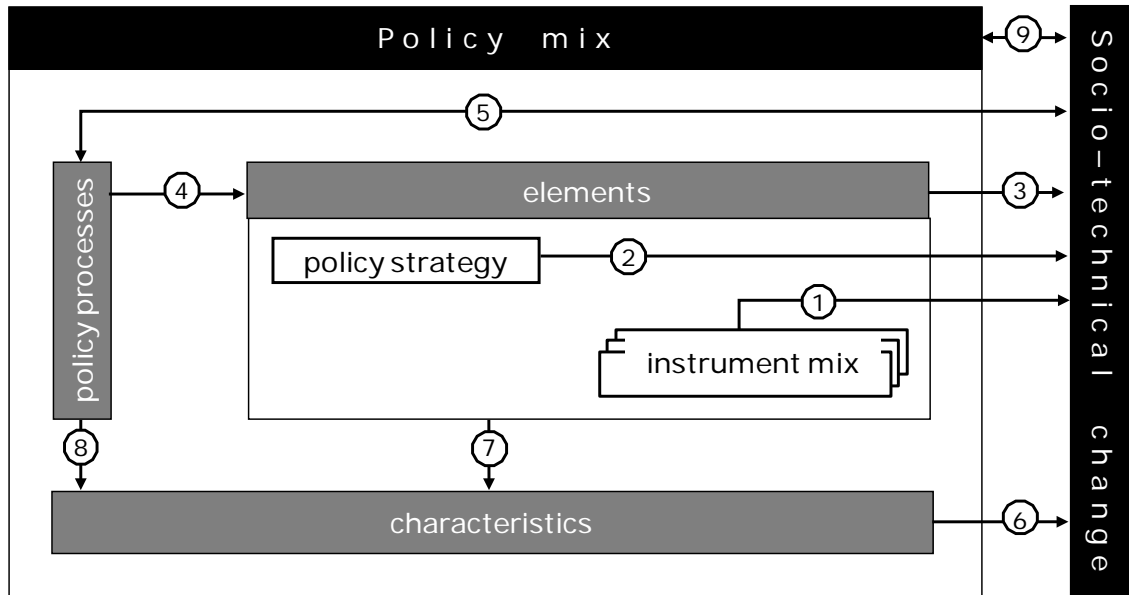
		P o l i c y   c o n t e n t		
		High level abstraction	Strategy level	Instrument level
P O L I C Y  F O C U S	<b>Policy Ends</b>	<i>Aims</i>	<i>Objectives</i>	<i>Goals</i>
	Lead question	What general types of ideas govern policy development?	What does policy formally want to achieve?	What are the specific requirements of an instrument?
	Operationalization	Vision	Targets	Settings
	<b>Policy Means</b>	<i>Logic</i>	<i>Principal Plans</i>	<i>Calibrations</i>
	Lead question	What general norms guide instrument preferences?	What is the proposed instrument pathway for achieving objectives?	What specific instrument type and design is utilized?
	Operationalization	Paradigm	Roadmaps	Type & design features
	<b>Policy Processes</b>	<i>Style</i>	<i>Strategizing</i>	<i>Implementing</i>
	Lead question	What general preferences guide policy making and implementation?	What processes govern strategy formulation and adaptation?	What processes govern instrument (mix) formulation and adaptation?
	Operationalization	Standard operating procedures	Strategy processes	Instrument processes

Source: Combination of Howlett and Cashore (2009) and Reichardt and Rogge (2016)

The extended policy mix concept for sustainability transitions was developed to provide an integrating analytical framework which may aid empirical research by pointing to previously neglected aspects to be considered in empirical policy mix studies, such as those analyzing the link between policy and socio-technical change. We argue that better policy design requires greater emphasis on evaluating the impact of existing policy mixes to enable better informed future policy design. Figure 3 therefore outlines how the three building blocks of the policy mix concept may relate to each other and to socio-technical change, with these linkages illustrated with numbered arrows representing avenues for future research informing policy design.



Figure 2: Framework for studying the link between policy mixes and socio-technical change



Source: Adapted from Rogge and Reichardt (2016)

For achieving sustainability objectives not only the instrument mix with its interacting instruments (1) but also the policy strategy (2) is important to consider, with their impact on socio-technical change likely being a joint one due to the combined effect of the elements of a policy mix (3) (Reichardt and Rogge, 2016; Schmidt et al., 2012, 2012). In addition, studies should go beyond analyzing how these elements of the policy mix come about and why they change (4) but combine this with an investigation of how the resulting strategies and instruments impact socio-technical change (4+3). Such a combined analysis of policy processes and elements may enable highlighting the impact of politics and power not only on targets and instruments but also on system innovation (Kern and Rogge, 2017). A closer look at the processes of policy making and implementation may also reveal a direct link between such policy processes and socio-technical change (5) (Reichardt et al., 2017). Of course, the impact of policy mixes can have repercussions for the evolution of the policy mix as it may have to be adjusted, for example due to technological developments (Hoppmann et al., 2014) or due to other feedback effects (Edmondson et al., 2017). Such patterns of the co-evolution of the policy mix and the socio-technical system can only be revealed through dynamic analyses, for example regarding the joint development of technological innovation systems and policy mixes for emerging green technologies (Reichardt et al., 2016). Finally, policy mix characteristics may be



crucial for assessing the performance of policy mixes (6) (Costantini et al., 2017; Reichardt and Rogge, 2016; Rogge and Schleich, 2017), and themselves may be determined by policy mix elements (7) and policy processes (8). In this context research should also investigate the interplay between different characteristics, such as between the consistency of the policy mix and its credibility. In conclusion, such extended policy mix analysis may significantly enhance our understanding of the complex links between policy and socio-technical systems and their co-evolution (9), thereby enabling better policy design.

Of course, such research is faced with multiple analytical challenges, among them the setting of the boundaries for the considered policy mix and its impact. For example, regarding the scope of the policy mix analysts have to decide whether it is sufficient to focus on green niches (Smith and Raven, 2012) or whether they also need to pay attention to including policy for competing technologies, such as subsidies (see chapter 15 in this handbook). In line with Kivimaa and Kern (2016) we suggest that research should not only include the policy mix creating the protected space for an emerging solution but also the policy mix of the encompassing system, thereby arguing for greater attention to destabilization policies. An example for deciding on the appropriate boundaries for the analysis, i.e. on the unit of analysis, concerns the relevant actors (e.g. authorities, companies, consumers) and their networks (e.g. industry associations and non-governmental organizations) to be included in the analysis of policy processes (Markard et al., 2016; Normann, 2017). One possible criterion for their inclusion may be their degree of influence and power in decision making. Clearly, boundary setting is by no means a straightforward exercise, and the initially set boundaries may change as the analysis proceeds.

Another analytical challenge concerns the operationalization of policy mix variables for empirical studies. Research does not only need to capture the relevant instruments with their design features, such as stringency (Botta and Koźluk, 2014), but may also need to identify long-term and interim targets and principal plans of the policy strategy. Such quantitative targets could then, for example, be integrated in a policy mix index, as was done by Hess and Mai (2014). For the analysis of policy processes researchers can draw on the standard methods and variables for operationalizing them (Howlett et al., 2009; Sabatier and Weible, 2014). Operationalizing policy mix characteristics may perhaps pose one of the greatest analytical challenges as official databases or documents typically do not capture such characteristics. Rather, their operationalization may require original data collection and interpretation (Costantini et al., 2017; Rogge and Schleich,

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2017). Overall, policy design studies applying the extended policy mix concept are likely to require the development, testing and further refinement of novel ways of operationalizing relevant policy mix components.

In conclusion, this chapter calls for assuming a broader policy mix perspective and unpacking the link between policy mixes and socio-technical change, for which we envisage three main areas of future research. First, empirical studies should analyze the interplay within and between the three building blocks of policy mixes and how such interplay affects socio-technical change. Second, the nature of policy processes – including the underlying politics – and their direct and indirect influence on the performance of policy mixes should be explored in more depth. Third, empirical research should investigate the determinants and relevance of policy mix characteristics, such as credibility. We argue that such greater emphasis on policy mix evaluation is a prerequisite for better informed policy design.

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